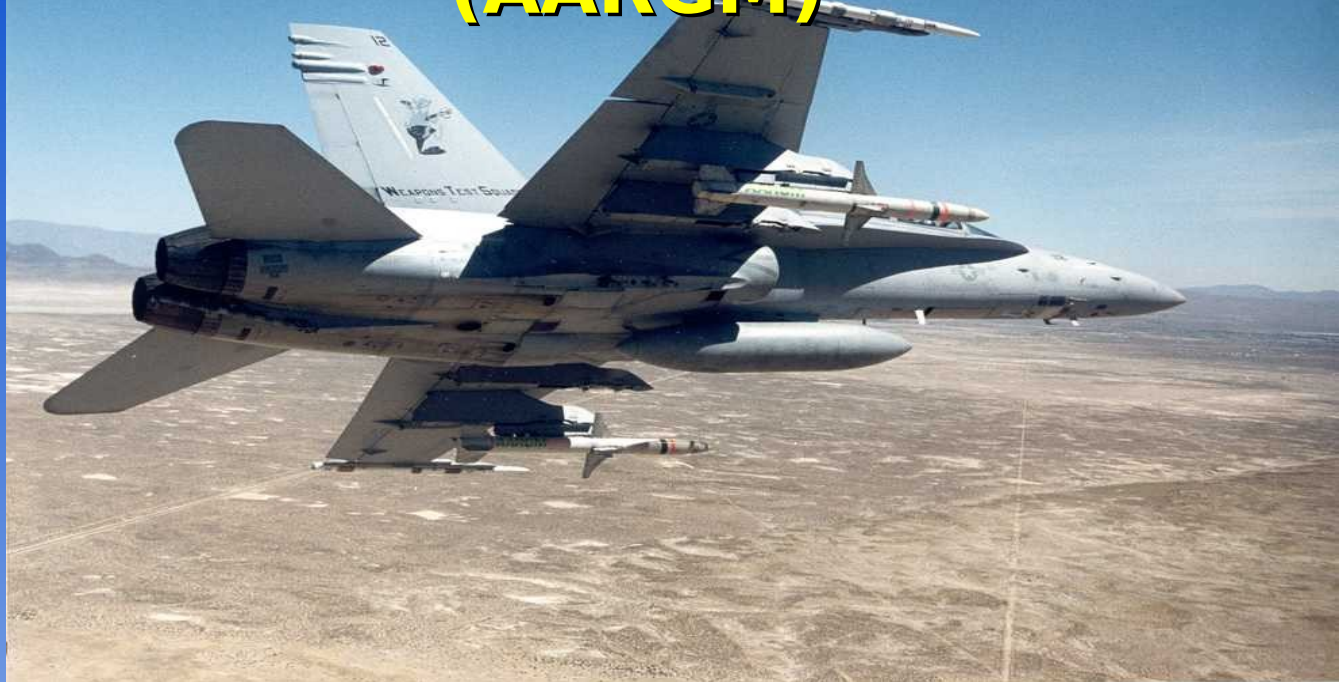
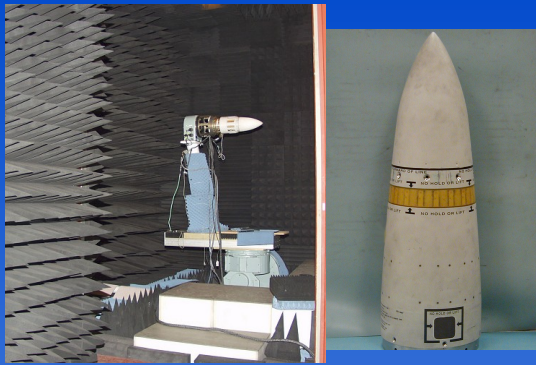


AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)



NDIA Gun & Ammo Conference

15 April 2004

Presented By:
Mr. Erik Ballinger

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Senior Engineer, Strategy and Business Development



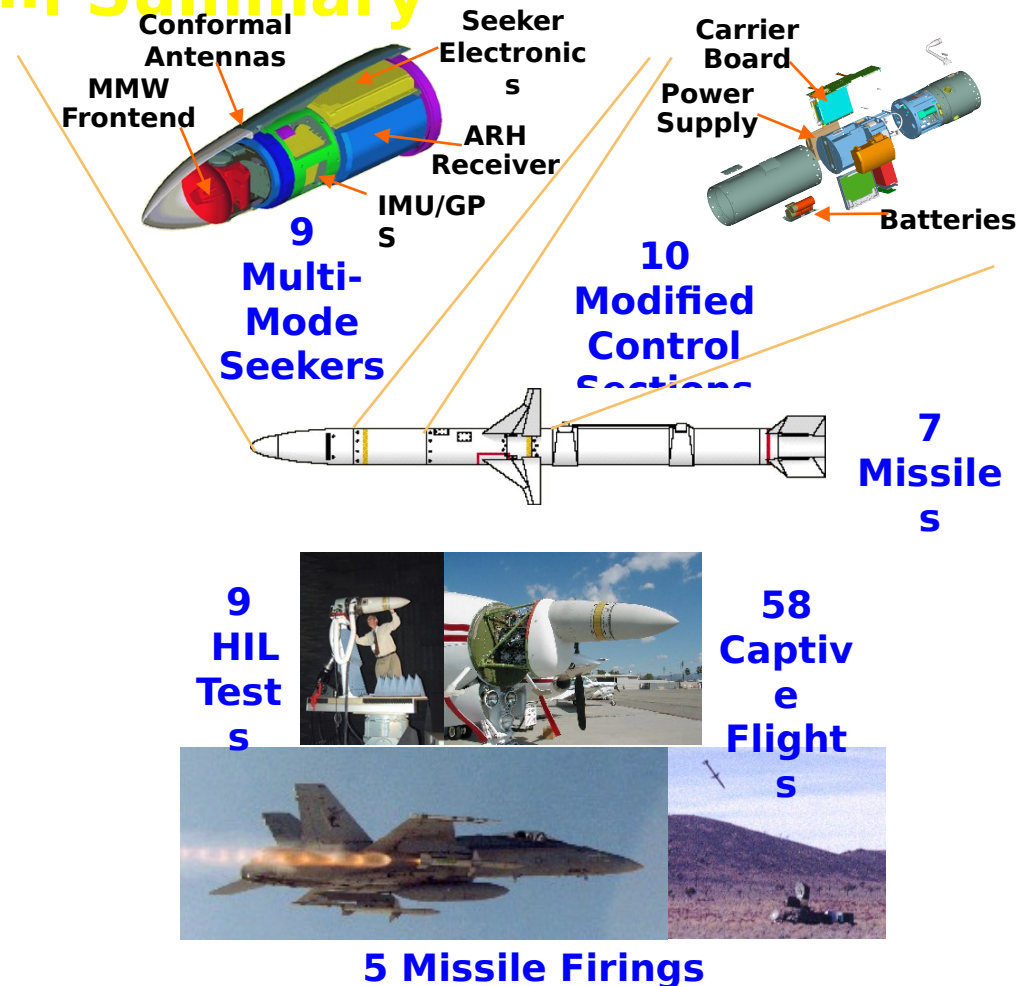
Briefing Purpose

- **Provide a summary of the AARGM/Quick Bolt demonstration programs**
- **Provide an overview and status of the AGM-88E AARGM system development and demonstration (SD&D) program**
- **Support Q&A**

Summary of AARGM/Quick Bolt Demonstrations

AARGM Advanced Technology Demonstration Program Summary

- Form-factored AARGM seeker design/fabrication
 - Passive ARH sensor
 - Active MMW sensor
 - GPS inertial navigation
 - Fused INS/ARH/MMW guidance
- AARGM seeker integration with the existing HARM airframe (AGM-88)
- Test and evaluation efforts
 - Chamber Testing
 - Hardware-in-The Loop
 - Brassboard captive flight tests
 - Control test vehicle firings
 - Guided test vehicle firings
 - Including Shutdown Scenario



ATD successfully demonstrated defeat of target shutdown with a multi-mode guidance section upgrade to HARM

Quick Bolt ACTD

Objectives

- **Demonstrate:**
 - Improved target location capability & pilot situational awareness
 - Support for bomb damage assessment efforts
 - Improved lethality and reduced fratricide potential
- **Enhance baseline AARGM ATD design and provide risk reduction for AARGM SD&D**

Sponsor: USEUCOM

System Concept

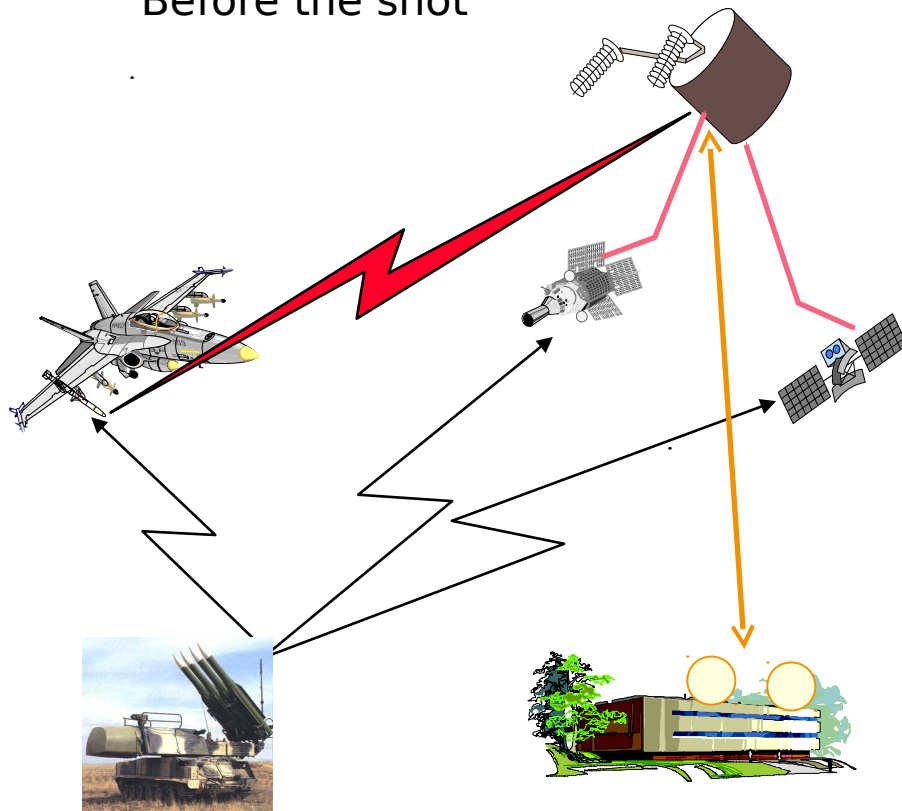
- **Integrate the Weapons Impact Assessment (WIA) Transmitter with the ATD design AARGM for connectivity between AARGM, National Technical Means, and IBS**
- **Integrate the ENTR Receiver and Producibility ARH full band antenna on a Captive Air Training Missile (CATM) for IBS connectivity to the aircraft**

Program Status

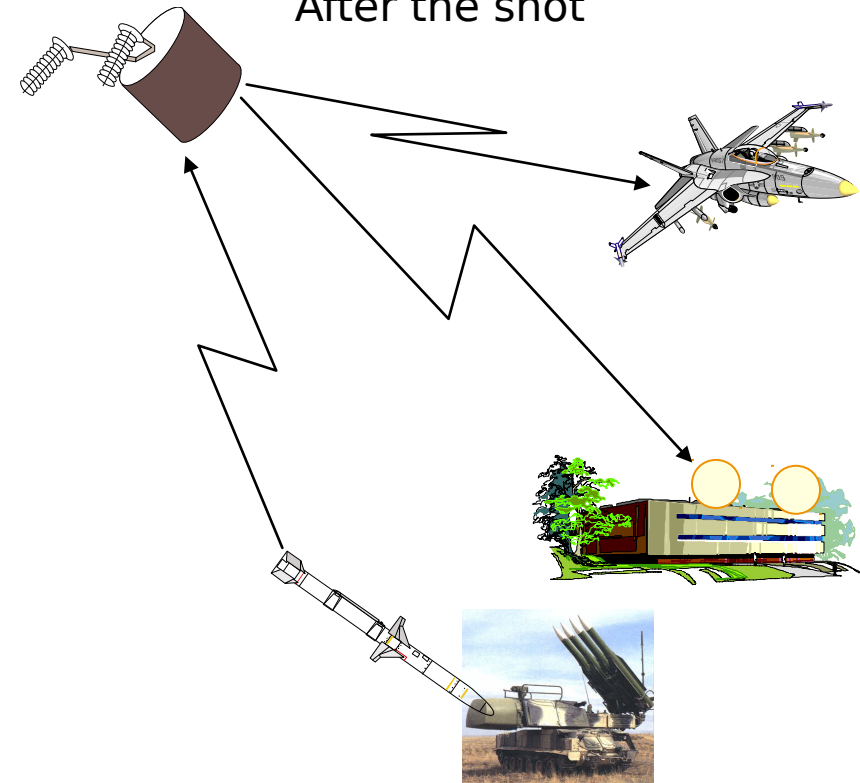
- **Successfully demonstrated Quick Bolt capabilities via HWIL, ground, captive carry testing and 2 live fire tests (11/15/02, 7/15/03)**
- **Delivered Residuals - 1 CATM and 1 Quick Bolt Missile**
- **Completed successful Military Utility Assessment by EUCOM**

Quick Bolt Network Centric Sensor-to-Weapon-to-Sensor Solution

Before the shot



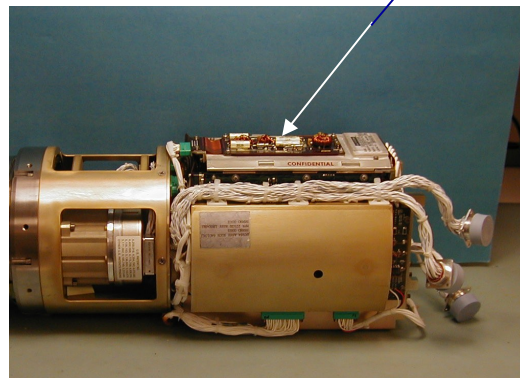
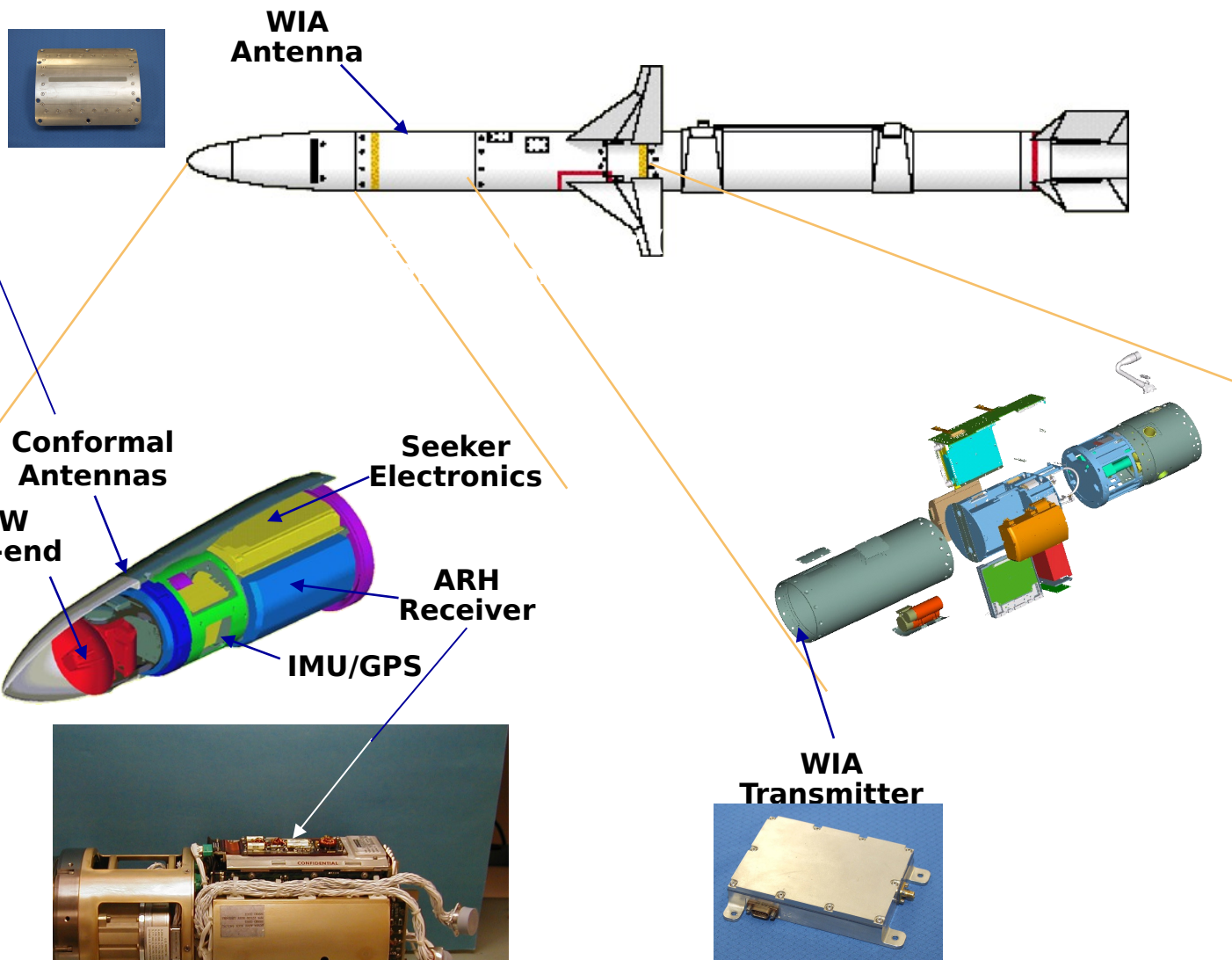
After the shot



a Net-centric Warfare capability to Tactical A

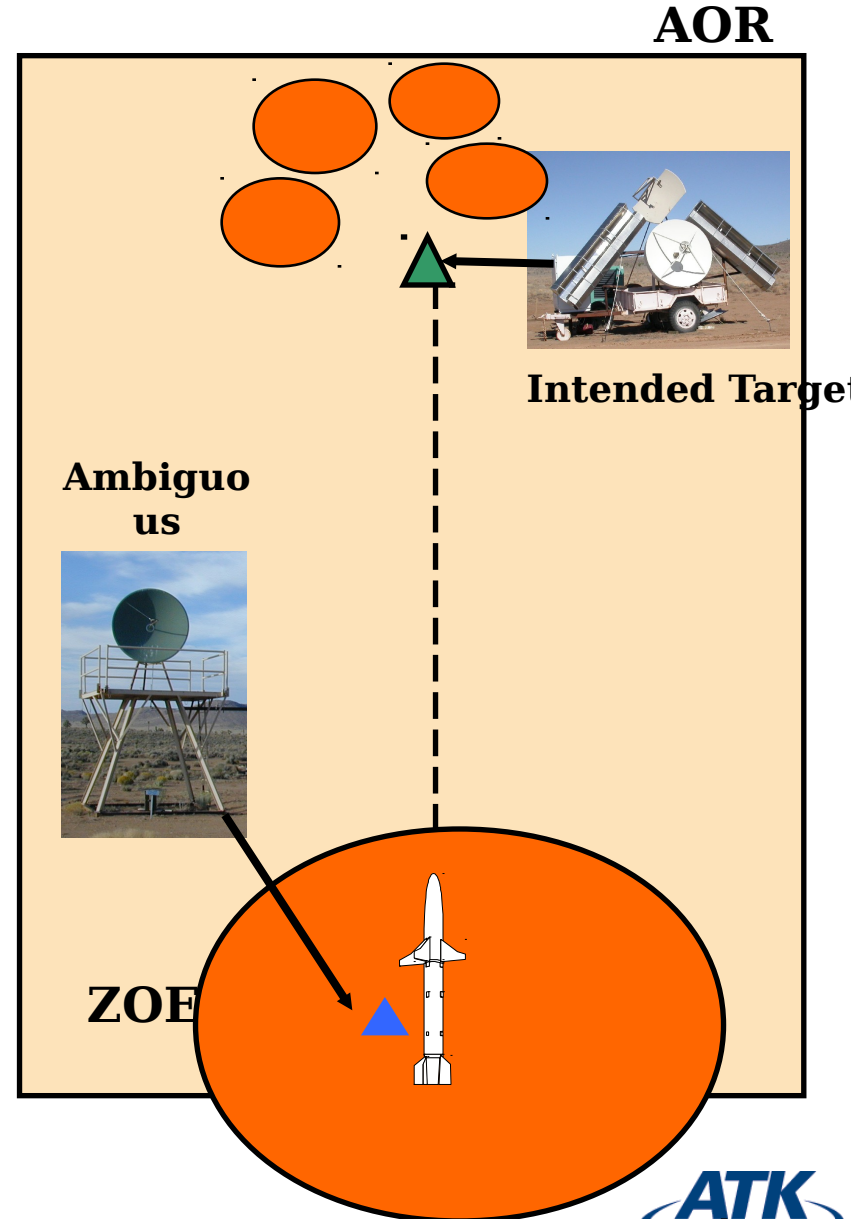
Quick Bolt ACTD Missile Configuration

AARGM ATD Missile + WIA Transmitter



Quick Bolt 2 Firing Engagement Scenario

- **A/C Parameters:**
 - Medium Altitude
 - Medium Range
- **Missile Mode:**
 - Range Unknown
- **Target Location Error:**
 - TLE Medium (<10-15% of range)
 - Area of Responsibility (AOR) established prior to A/C launch
 - QB ENTR Off-board cue prior to msl launch
- **Target Type:**
 - Typical SWA target
 - Ambiguous target located in AOR
 - Intended target shuts down with 30 seconds to go while ambiguous target continues transmitting
- **Constraints:**
 - Multiple zones of exclusion/impact avoidance zones (ZOE/IAZ) in AOR



Quick Bolt 2 Firing

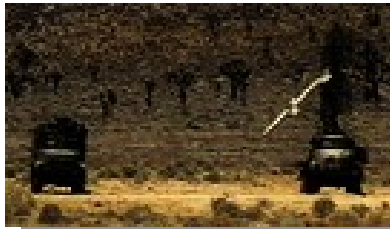
All Success Criteria Met

- AARGM Mission Plan Download - ACHIEVED
- CATM RECEPTION of TDDS Broadcast - ACHIEVED
- ARH/TDDS correlation and Cockpit Display - ACHIEVED
- Target Download to Missile and Launch - ACHIEVED
- Ambiguous Target Rejection - ACHIEVED
- ARH Accuracy Through Shutdown - ACHIEVED
- MMW Selection of the Target - ACHIEVED
- Guidance Within Lethal Range - ACHIEVED
- Warhead Fuze Pulse Within Lethal Range - ACHIEVED
- WIA message Reception at BDA Cell - ACHIEVED



AARGM/Quick Bolt Test Firing Summary

Highly Successful Demonstration Programs



	Launch Date	GPS	ARH	MMW	SHUT DOWN	GEO SPEC	WIA XMIT	ENTR CORR
CTV-1	Mar 23, 2000	✓						
CTV-2	June 19, 2000	✓						
GTV-1	Aug 28, 2001	✓	✓					
GTV-2	Dec 21, 2001	✓	✓	✓				
GTV-3	Aug 29, 2002	✓	✓	✓	✓	✓		
QB-1	Nov 15, 2003	✓	✓	✓	✓	✓	✓	
QB-2	July 15, 2003	✓	✓	✓	✓	✓	✓	✓

SUCCESS



AGM-88E AARGM SD&D Program Overview

AARGM AGM-88E

Performance Objectives

- **Improved Lethality:**
 - Destroy current and projected *IADS* employing countermeasures including shutdown
 - Engage Elements of an ADU
 - Engage Non-Emitting Mobile/Time Sensitive/Non ADU Targets
- **Reduced Fratricide**
 - Geographic Specificity
- **Improved Targeting**
 - Wider FOV/Off-board Correlation
- **Support Battle Damage Assessment**
- **Affordable retrofit of existing HARM**

The AARGM program will provide a cost-effective weapon that will detect, identify, engage and destroy current and projected enemy integrated air defenses (IADS) and other time-critical targets.



AARGM AGM-88E

Enhanced Performance Capabilities

ARH Subsystem

- Significantly enhanced sensitivity for improved threat detection
- Significantly enhanced direction finding accuracy for improved target location
- Significantly expanded field of view for improved situational awareness
- Expanded frequency coverage
- Correlation with off-board threat

Navigation Subsystem

- Incorporation of SAASM GPS, precision IMU & DTED data
- Reduced fratricide via geographic specificity
- Expanded strike capabilities with PTP mode
- Increased probability of kill through accurate guidance
- Decreased vulnerability to GPS signal

- ***Results in significantly improved capability to destroy existing and projected enemy air defense systems***
- ***Provides tactical aircraft a significant new time sensitive strike capability***

- Off-board threat/targeting data via IBS receiver and correlation with ARH subsystem for enhanced threat location/verification/ situational awareness
- Weapon impact indication via WIA transmitter to verify weapon status/impact and to assist in the BDA process

- Counters threat radar shutdown tactics
- Expands target set to non-emitters
- Large search footprint to counter mobile/ moving targets
- Effective in presence of battlefield obscurants/ weather

AARGM AGM-88E

Concept and Key Features

Key Features

Capabilities

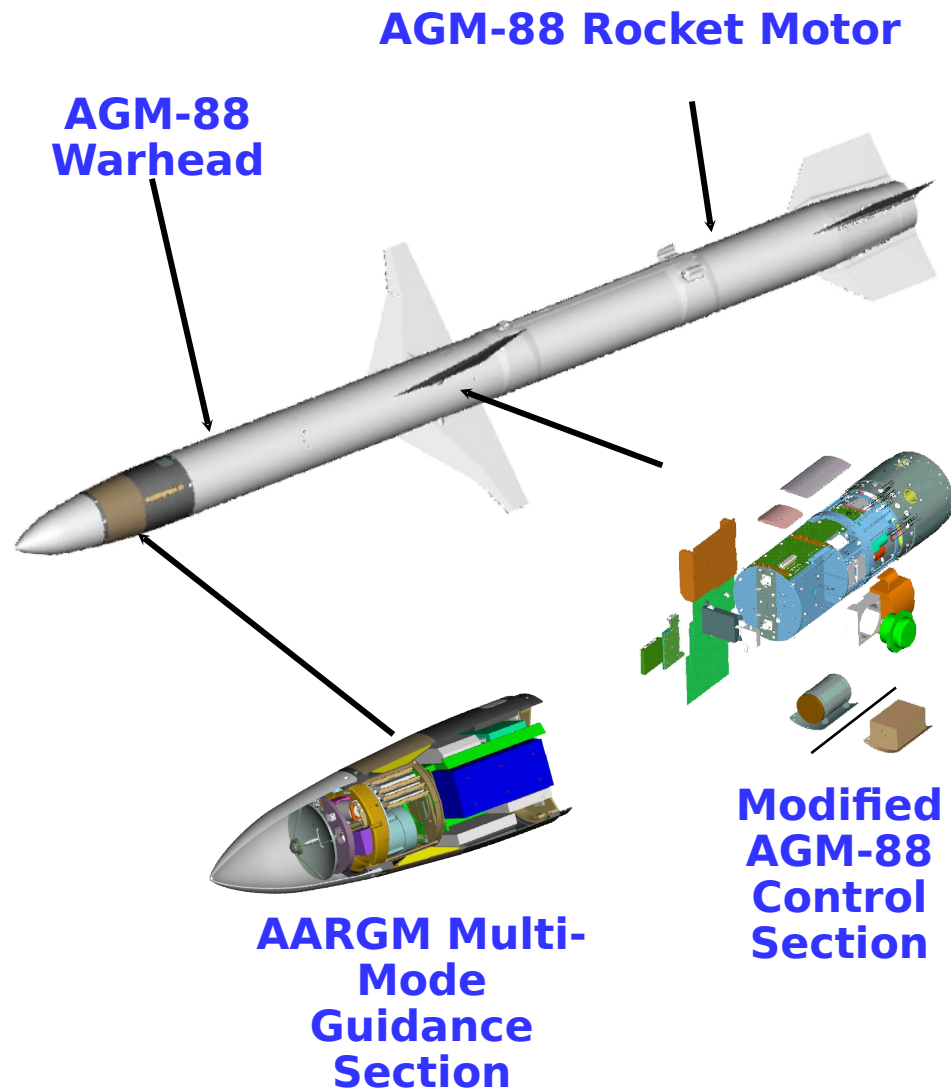
- Destroy Advanced IADS
- Provide Greater Lethality
- Ensure Geographic Specificity
- Support BDA
Support/Situational
Awareness

Sensors

- Digital ARH Receiver
- MMW Terminal Sensor
- DTED-aided SAASM GPS/INS
- National Systems Transmitter
and Receiver

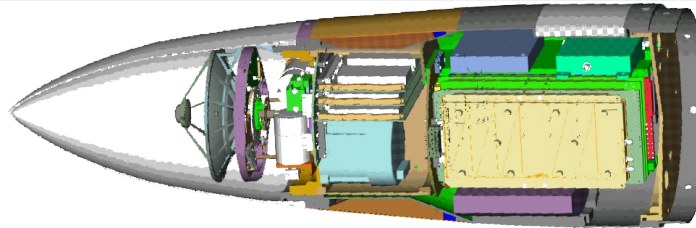
Physical (Same as HARM)

- Length - 164"
- Diameter - 10"
- Weight - 795 lbs

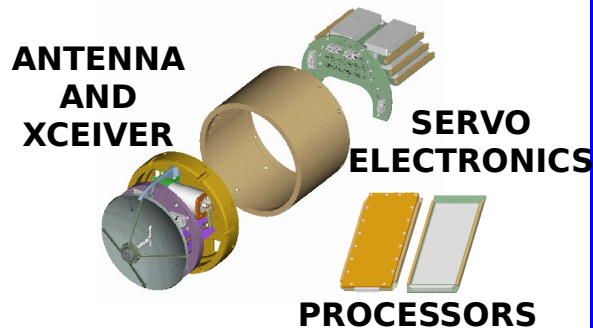


AARGM AGM-88E

Guidance Section Overview

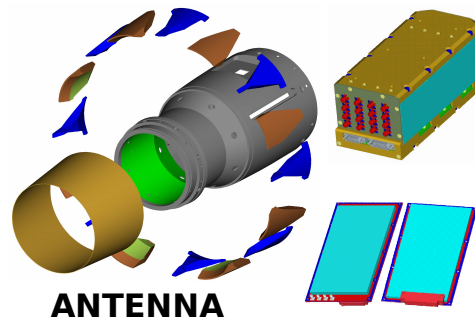


Active Radar Seeker



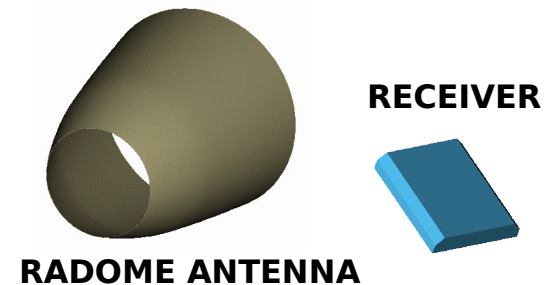
- Performs terminal target acquisition and track
- Large search area counters target movement/shutdown
- Expands AARGM target set to non-emitters

Passive Anti-Radiation Homing Seeker



- Increased sensitivity, frequency band, and field-of-view with digital design
- Autonomous target detection, Identification
- Precision DF enables on-aircraft emitter location

QB Receiver



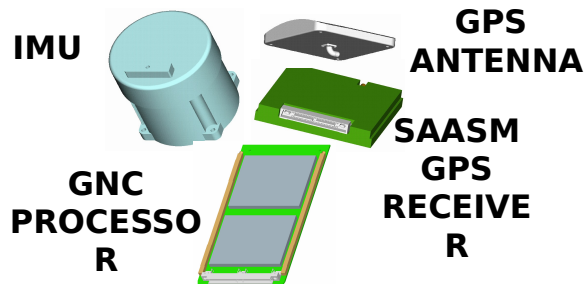
- Receives off-board target information
- Fused with ARH data to form correlated target location/type/ track file
- Enables off-board targeting and enhanced cockpit situational awareness

High-performance, multi-mode seeker ensures intended target destruction in countermeasures environment.

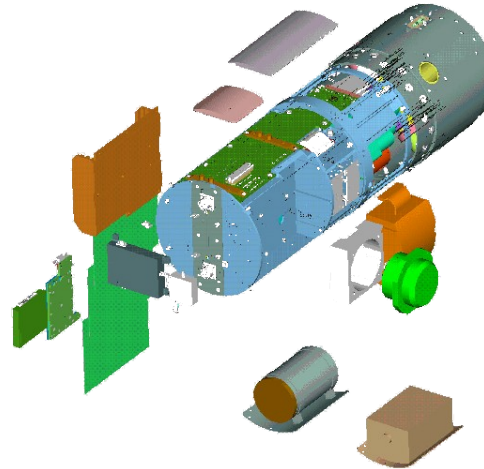
AARGM AGM-88E

Common Control Section

Guidance, Navigation, and Control Subsystem



- High performance INS with tightly coupled IMU/SAASM GPS RCVR integrated with DTED data
- Enables fratricide reduction and precision target engagement



Power Subsystem

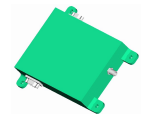
- Power Supply
- Battery

Weapons Impact Assessment Subsystem

ANTENNA



TRANSMITTER



- Connectivity with off-board sensors
- End game transmission of missile state and impact
- Enables near real-time BDA support
- Ensures weapons impact location verification

Modular control section design allows for backward compatibility with legacy HARM weapons for precision navigation/point-to-point capabilities.

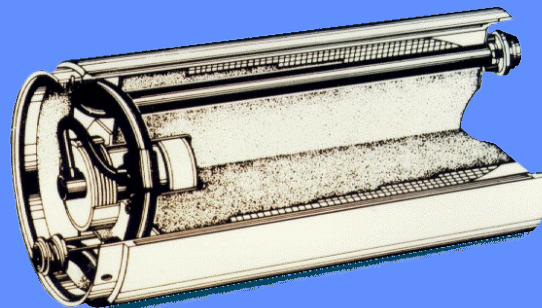
AARGM AGM-88E Warhead

Effective Against a Wide Range of Targets

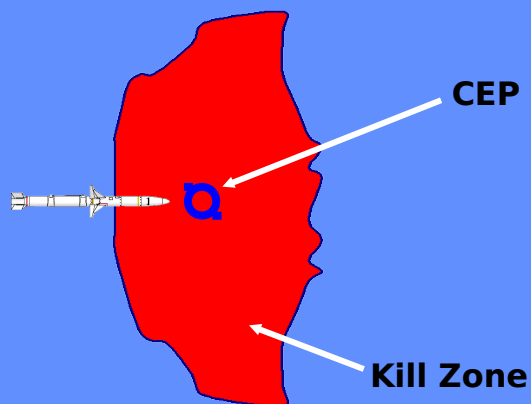
Features

- Existing HARM WAU-7/B
- Blast/Fragmentation Design
- 144 Pounds
- > 25,000 Steel Fragments
- PBXN-107 Explosive

Design



Blast Pattern



Effects



AARGM AGM-88E

Interfaces and Compatibility

Aircraft

Baseline Integration



Potential Integration



Interfaces

- **1553 and HARM Legacy Data**
 - Compliant with HARM-PNU AS-5186/5108 Interface Specifications
 - MIL-STD-1760C Class II Interface Capable
- **Standard A/C Power**
 - 3 phase 115 VAC, 400 Hz, < 500 W

Environment

- Compliant with F/A-18 C/D/E/F/G vibration environment
- Designed to withstand 200+ catapult launches & trap landings
- -40° to +71° C Operational Temperature range
- Adverse Weather Availability (Rain, fog, clouds, snow)
- EMI Resistant (Tailored Mil-Std 464, Shipboard Emitters)

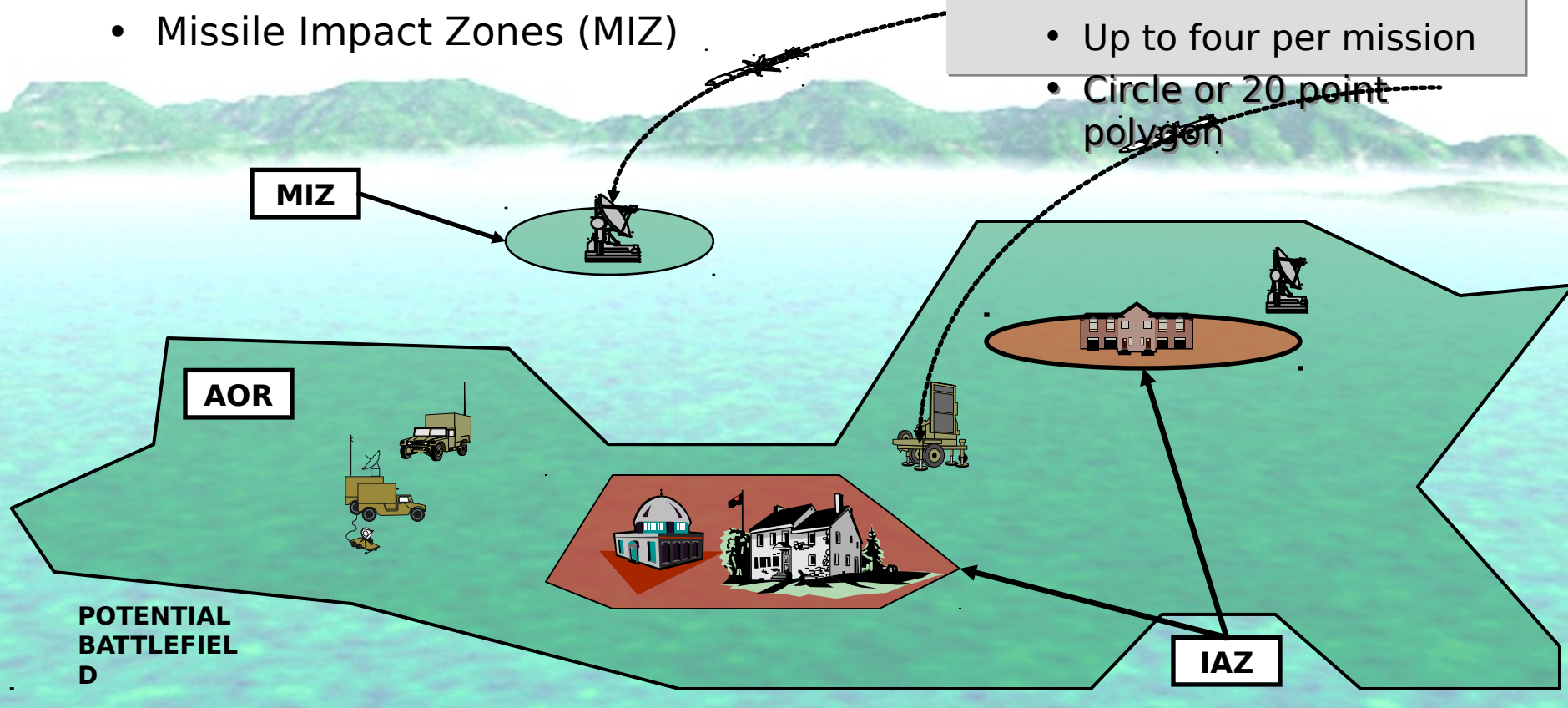
AARGM AGM-88E

Geographic Specificity

Employment in restrictive ROE

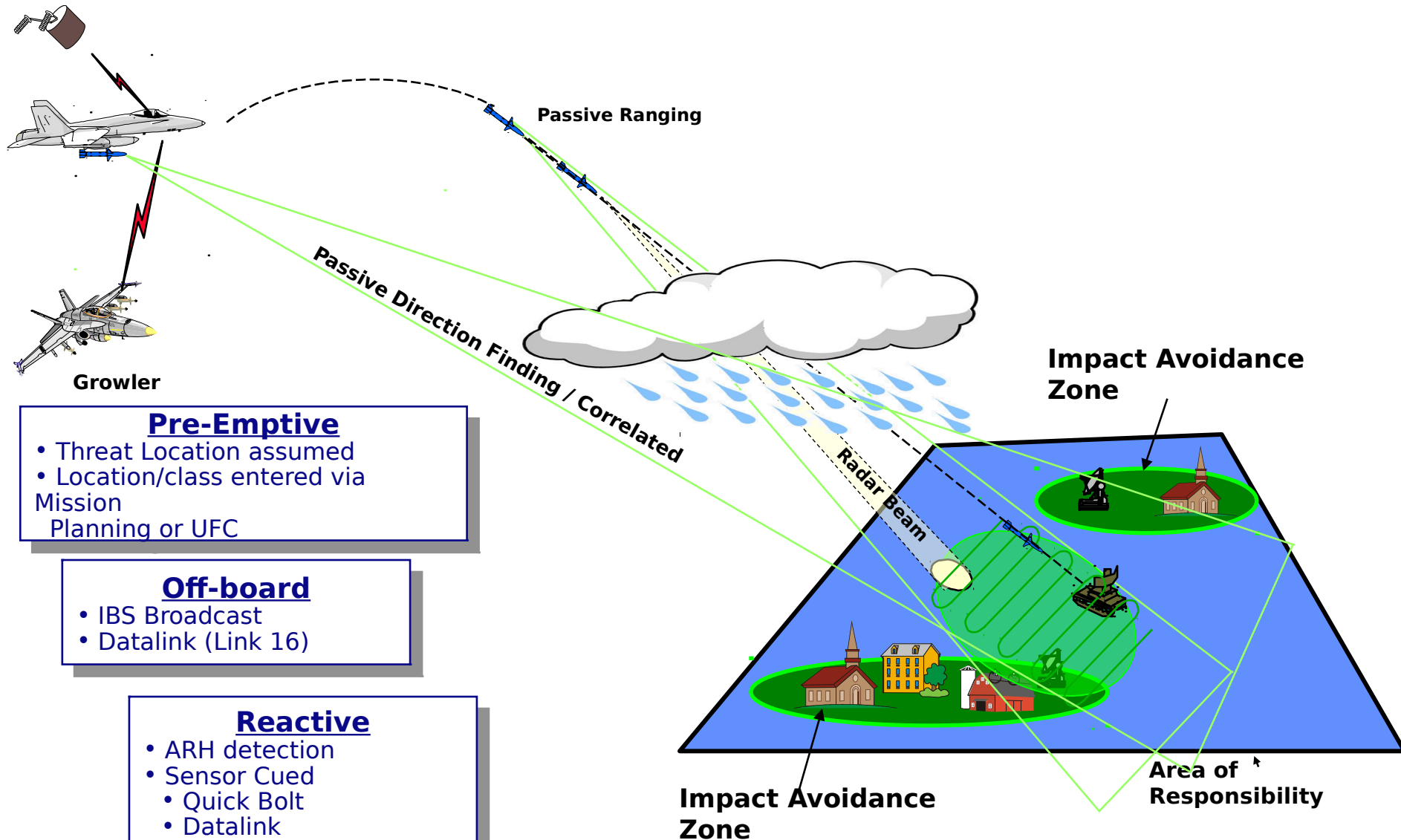
- Area of Responsibility (AOR)
- Impact Avoidance Zones/Zones of Exclusion (IAZ/ZOE)
- Missile Impact Zones (MIZ)

- Geo-Pack
 - Combined AOR + IAZ data
 - Up to four per mission
 - Circle or 20 point polygon



AARGM AGM-88E

Targeting Options



AARGM Program Summary

- **ATD/Quick Bolt ACTD successfully completed July 2003**
- **SD&D contract (\$222.6M) signed June 03**
 - **Efforts planned through September 2008**
- **Production is planned from 2008 through 2015**
 - **Production run estimated at 1750 units for USN**
 - **Potential for one year acceleration for LRIP with recent Navy budget actions**
- ***AARGM program is on track to deliver a greatly enhanced SEAD/strike capability to USN***
 - ***Provisions are under way to address international interest***

Contacts

For follow-up information or questions regarding the AARGM program please contact:

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